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O. WING

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ELECTRICAL SLEEP MACHINE AND SLEEP INDUCING METHOD

Filed March 22, 1963

2 Sheets-Sheet 1

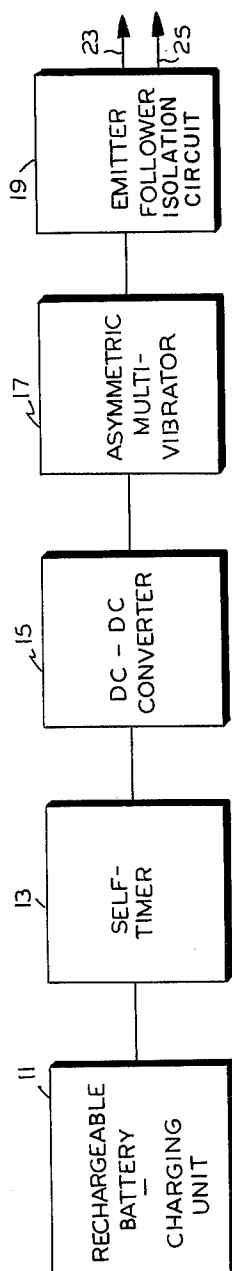


FIG. 1

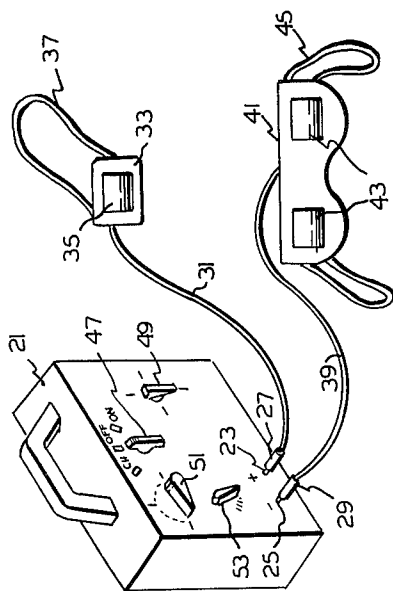


FIG. 2

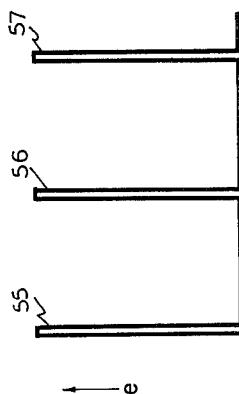


FIG. 3

INVENTOR
OMAR WING

BY *Fisher, Christen, Sabol & Caldwell*
ATTORNEYS

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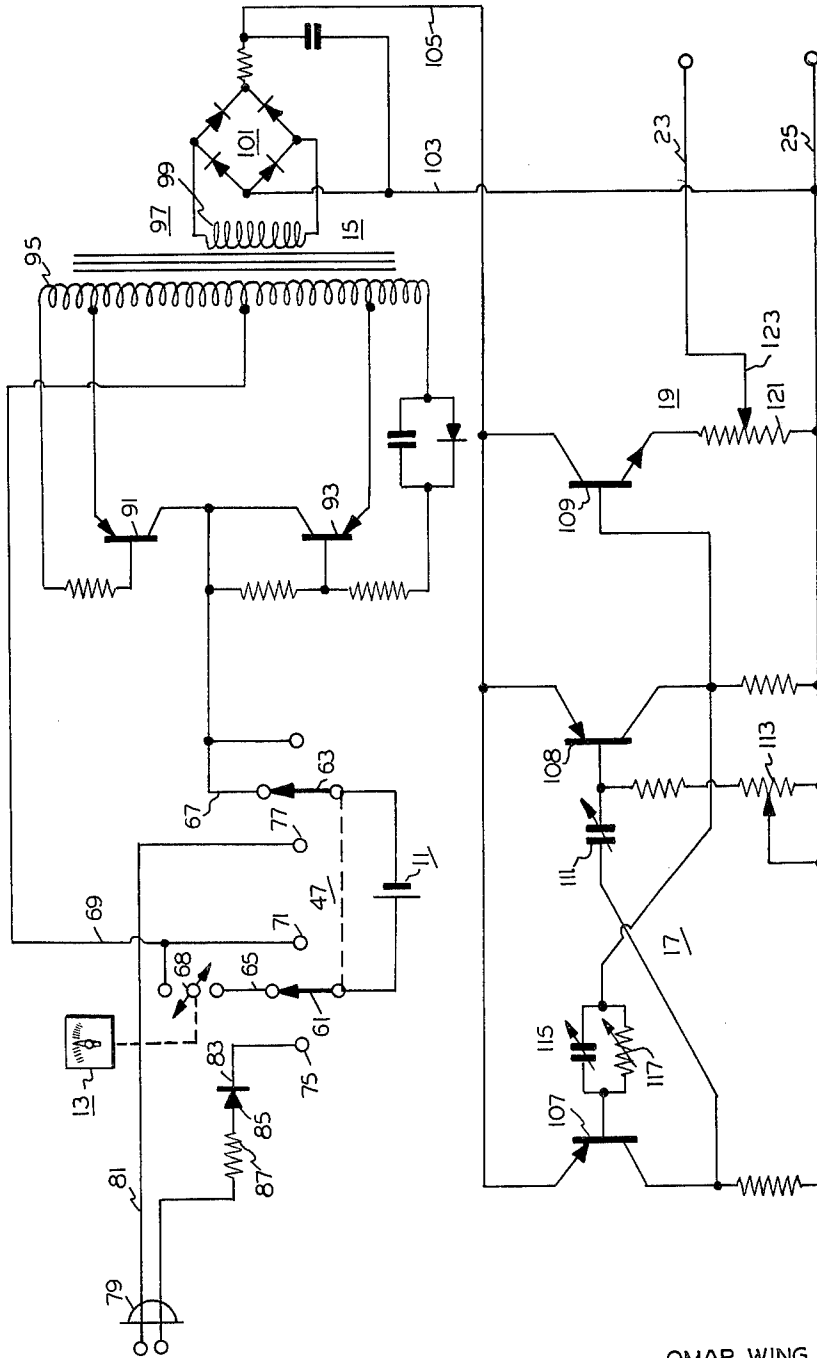


FIG. 4

INVENTOR

OMAR WING

BY *Fischer, Christen, Seibel & Caldwell*
ATTORNEYS

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ELECTRICAL SLEEP MACHINE AND SLEEP INDUCING METHOD

Omar Wing, New York, N.Y., assignor to National Patent Development Corporation, New York, N.Y., a corporation of Delaware

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4 Claims. (Cl. 128—421)

The present invention relates to an improved type apparatus for the application of electrical energy to a patient to induce relaxation and sleep. The novel method for producing this reaction consists of the application of energy characterized by distinctive wave form, rate of repetition and the manner of application of the electrical wave to the human body.

For many years now, various type electrical therapeutic devices have been the subject of patents, with their objectives being quite diversified, but their circuitry in general being subject to universal disadvantages. Primary among such disadvantages are the following:

Due to the fact that the output energy is invariably drawn from the anode circuit of an electron discharge tube, the applied energy is not continuously under control. Since the patient serves as the plate load for such discharge devices, this condition is often intolerable.

While in certain prior art therapeutic devices, this factor is immaterial because a relaxed condition is not sought, nevertheless in sleep inducing machines it becomes most critical because of such factors as safety, rhythm, tranquility and uniformity. The biological characteristic of a human being in a taut or unrelaxed state is quite different from that of the same human in a relaxed condition or during sleep, as is also the case between different persons. Thus, the effective load is subject to change and the prior art devices suffer the inability to maintain the effective voltage strengths through the patient for the various physiological conditions encountered.

Also, the potential to take a life is latent within all, or at least a great percentage, of the prior art therapeutic devices. This lethal fault could manifest itself upon the mere shorting of circuitry, even within an electron discharge device, a well known common occurrence. Primarily, this situation is caused by the fact that such devices are operative directly from conventional 110-volt mains, an energy source known to have caused many fatalities over the years.

Other purely technical disadvantages plague the present-day equipment. For example, undue complexities are built into the devices to compensate for the unstabilized output conditions. Various approaches toward resolving this problem have included the inclusion of feedback arrangements with separate amplifying stages; added stages of control; separate amplifiers and even auxiliary wave form shapers, such as extra oscillators and the like. Additionally, a common misconception was the necessity for the generation and application of excessive power to the patient, resulting of course, in costly overdesign of the equipment, which usually utilized but a fraction of the equipment capabilities.

The present invention provides an apparatus which obviates all of the foregoing disadvantages while providing a sleep inducing apparatus of inexpensive, optimum design capable of influencing the patient in accordance with the novel method hereof. The circuit of the present invention has been developed to utilize transistors in order to obviate the high voltage problem and to miniaturize, to simplify and to lend portability to the apparatus. A five transistor embodiment is disclosed which operates from an extremely low power, portable source, such as a safe, 3.6 volt, rechargeable nickel-cadmium battery, which may be smaller than an ordinary flashlight dry cell.

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A multi-functional switch is provided to connect, in one of its positions, the rechargeable battery to a D.C. to D.C. converter, for stepping up the voltage to make available approximately 18 to 24 volts for driving an asymmetric multivibrator to generate the desired pulse-type wave shape. A single transistor emitter-follower stage receives the pulses from the multivibrator to serve as an isolating output stage for the sleep inducing apparatus.

A pluggable connection for one of the output terminals extends to a single applicator pad adapted to fit the nape of the neck, being retained by an elastic loop. The elastic loop extends about the forehead to secure the electrode firmly against the nape skin, a brine solution being used to saturate the pad for establishing good electrical contact. The other electrode includes an eye cover provided with saturable pads to fit against the closed eyelids, being retained by an elastic band extending about the back of the head. Thus, it will be appreciated that the current path is from the machine, into the nape of the neck, and out either eye, to the return lead.

A feature of the invention resides in the use of a rechargeable nickel-cadmium battery which can be connected to a wall outlet, through the multi-functional switch, for recharging when the machine is not in use. The multi-functional switch, among other safeguards built into the circuitry, insures that the full A.C. main voltage could never be applied, through the machine, to a user, under any circumstances. In addition, a self-timer is built into the device for turning off the apparatus after a predetermined interval. This permits self-operation of the apparatus by the user who may merely set the timer to an interval sufficient for his purposes of relaxation or to cover the period necessary to lull him asleep.

In the method of practicing the invention, electrical energy is applied to the head of the patient as described. The energy is characterized by a voltage pulse train having a repetition frequency, approximately in the range of 30 to 40 cycles per second, with a pulse width substantially of 1.8 to 2.0 milliseconds, and a pulse height of 18 to 24 volts. The preferred shape of the pulse is substantially rectangular, but it may be appreciated that the energy is applied in spike-like bursts, which produce a tingling or similar sensation in the region of the eyelids. As a matter of fact, users have described the experience as including the sensation of impressions of alternate black and white colors in the mind until the white disappears, presumably sleep occurring when everything becomes black.

The circuitry is provided with controls for adjusting the period, pulse width and voltage level of the applied energy. The user may manipulate these controls, adjusting the input to his body, until the sensations become slightly uncomfortable, at which point the controls are not further adjusted and the machine simply carries out its intended function automatically.

With the foregoing in mind, it is among the objectives of the foregoing invention to provide a novel method for effectively producing relaxation or sleep in a human being.

It is a further object to effect sleep in a patient by applying energy in the form of a pulse wave train having a pulse repetition frequency of about 30 to 40 cycles per second, a pulse width of about 1.8 to 2.0 milliseconds, and a pulse height in the vicinity of 20 volts.

It is a further object of the invention to provide a portable, harmless sleep inducing apparatus, preferably comprised of low voltage components.

A still further object of the invention is the provision of such an apparatus equipped with a rechargeable battery circuit and adjustable self-timer.

Further objectives and advantages of the invention will be apparent to those skilled in the art from a reading of

the following detailed description thereof when viewed in the light of the accompanying drawings wherein:

FIG. 1 is a block diagram of a typical circuit in accordance with the invention.

FIG. 2 is a view in perspective of the portable device with suitable electrode attachments for application to a patient.

FIG. 3 is a schematic wave form diagram, showing the preferred type energy useful for causing sleep; and,

FIG. 4 is a transistorized circuit for producing the wave form of FIG. 3, and applying the same to a human.

The block diagram of FIG. 1 indicates basic components which it is desirable to employ in the apparatus of the present invention; however, depending upon the application, certain functions indicated by the various blocks may be unnecessary to particular applications. The extreme left hand block 11 identified by the legend "Rechargeable Battery-Charging Unit" includes a suitable rechargeable battery of, for example, the nickel-cadmium cell type, having an output voltage specification of 3.6 volts and adapted to be recharged from an ordinary household 110-volt A.C. main. Thus, the charging unit portion of block 11 may be considered as means for plugging the unit into a 110-volt main and, of course, a suitable switching arrangement is provided whereby the battery is disassociated from the remainder of the circuit during charging.

The self-timer 13 represents a timer which is capable of being set to any number of predetermined time intervals and which includes a connection or switch between the battery source 11 and the remaining portion of the apparatus. Once the timer is set, a path is closed from the apparatus to the battery and remains closed until the predetermined period has elapsed, at which time the timer disconnects the battery from the sleep inducing apparatus to relieve the energy application.

A D.C. to D.C. converter 15 is adapted to receive the low value voltage from the battery block 11 and to step it up, as by chopping and transformer action, to a higher value which is rectified and made available for operation of the pulse wave producing equipment.

The basic wave former and producer is illustrated as the asymmetric multivibrator 17, adapted to supply pulses (which are adjustable in both rate of occurrence and width) to an emitter-follower amplifier 19 serving as the output stage, also capable of providing magnitude adjustment of the pulses delivered by the apparatus.

A perspective view of the portable transistorized sleep inducing machine is shown in FIG. 2, wherein a casing 21, which may measure as little as 6" x 5" x 2" in external dimensions, is adapted to house the circuitry. The output terminals 23 and 25 (FIGS. 1 and 2) are respectively designated positive and negative and are adapted to receive the pluggable jacks 27 and 29 of the attachment pieces for the patient. Jack 27 is connected by lead 31 to a patch-like holder 33 having affixed to one surface thereof an absorbable pad 35 and being attached to an elastic band 37. The negative connection, including jack 29 and lead-in wire 39, extends to an eye cover 41 which also includes absorbent pads 43 and an elastic 45 for retaining the path on the patient's head.

The positive attachment, including the patch holder 33, is adapted for connection to the patient's head with the salt water soaked pad 35 being placed into contact with the nape of the neck in a region corresponding to the main hair line on a male. The positive connection attachment of course enables the covering of the patient's eyes with the cover 41 to dispose the wetted pads 43 in fairly tight contact with the closed eyelids through the pressure of the head gripping elastic band 45.

In operation, once the patient is connected, the On-Off-Charge switch 47 is set to the "On" position (right hand position) if the self-timer is not used, to connect the battery block 11 to the remaining portion of the apparatus. If the self-timer is used, switch 47 is set at the "Off" position, and the timer switch 49 is rotated to a predeter-

mined time setting and the patient may adjust or at least direct the adjustment of the frequency switch 51 and the pulse amplitude switch 53. The frequency switch 51 is normally adjustable between 30 to 40 cycles and a typical setting is 33 or 34 cycles. Thereafter, it is usual to adjust the pulse amplitude switch 53, increasing the energy supplied until the patient feels a slight tingling or discomfort, at which point the machine continues to operate, without any requirement for supervision or further adjustment, to supply energy in the form of the pulses 55-57 (FIG. 3) to the body of the patient.

The method of the invention requires the application of energy in the spike-like form of FIG. 3 at the rate of 30 to 40 pulses per second. The pulse width is approximately 1.8 to 2.0 milliseconds, and thus in any given second, energy is applied for only about eight one-hundredths (0.08) of the time. Nevertheless, it is applied in a rhythmic impingement which is apparently irresistible and induces deep sleep, usually within an interval of 4 to 8 minutes. It has been found that even persons not wishing to succumb to the machine readily fall asleep under its effects.

The transistorized version of apparatus suitable for carrying out the described method is shown in FIG. 4, wherein the rechargeable battery is indicated at 11, the self-timer at 13, the D.C. to D.C. converter at 15, the asymmetric multivibrator at 17, and the emitter-follower amplifier at 19.

The On-Off-Charge switch 47 is shown as including ganged contacts 61 and 63. As illustrated in the figures, the switch is in its "Off" position, with contact 61 closed to lead 65 and contact 63 closed to input lead 67, because the timer switch 68 is open, and thus no connection is made to the other input supply lead 69. The switch 68 is shown in its open or "Time Expired" position, as controlled over the dotted line, by the timer 13.

The "On" position, without timer control, is made when connection is established by terminals 71 and 73, by contacts 61 and 63 to supply the battery voltage directly to the converter 15.

The "Charging" position is indicated by terminals 75 and 77 because with contacts 61 and 63 closed on these terminals, the plug 79 is adapted for connection with a 110-volt main to supply D.C. over leads 81 and 83 to these terminals, the latter lead including the series connected rectifier 85 and resistor 87.

The D.C. to D.C. converter 15 may be of standard design, including a pair of power transistors 91 and 93 tapped into the primary winding 95 of a transformer 97 to provide chopped-up voltage capable of being stepped-up by transformer 97 and introduced, by its secondary winding 99, to a full wave rectifier bridge 101. The output of the bridge 101 appears on leads 103 and 105 which establish operating potential for the two multivibrator transistors 107 and 108, as well as the emitter-follower transistor 109.

The asymmetric multivibrator 17 may also be of conventional design, provided that either or both of the capacitor 111 and resistor 113 are made adjustable in order that the period of the wave train may be controlled. The adjustable control of resistor 113 is indicated by the knob 51 in FIG. 2. Also, either capacitor 115 or resistor 117 should be adjustable to provide control of the pulse width, which adjustment is not brought out on the face of the instrument but is available for factor control and adjustment purposes.

The emitter-follower stage 19 provides stability, isolation and power amplification for the D.C. pulses developed across its output resistor 121. Adjustability of the pulse magnitude is afforded by tape 123 and is shown as knob 53 in FIG. 2.

In any event, the wave train of FIG. 3 is adapted to be delivered on output leads 23 and 25 for application to the patient via attachment holders 33 and 41 of FIG. 2.

By way of example, the power transistors 91 and 93 may be of the 2N1172 type, the multivibrator transistors 107 and 108 may be of any suitable audio type, such as 2N34, and the output or emitter-follower transistor 109 may comprise a 2N35 type or its equivalent. Suitable values for the controls which determine the pulse repetition frequency and individual pulse width are as follows:

R117	-----ohms--	330,000
C115	-----microfarads--	0.01
R113	-----ohms--	200,000
C111	-----microfarads--	0.2

The output resistor 121 is a variable resistor of 50,000 ohms.

The converter 15 is capable of stepping up the D.C. supply voltage from 3.6 volts to about 24 volts. It should again be emphasized that the output stage 19 serves the important function of providing an output which is substantially independent of the variations of the electrical characteristics of external circuits thereto. Thus, the output pulse train remains substantially constant in amplitude, width and period, as the electrical impedance due to the physiological elements varies from person to person and condition to condition. This function, moreover, makes it possible to connect the machine, by means of multiple output connector connected to terminals 23 and 25, to several patients at the same time without deteriorating the pulse width, pulse height, and the repetition frequency.

While the invention has been described in relation to certain preferred embodiments thereof, it nevertheless will be apparent to those skilled in the art that certain modifications may readily be made within the scope of the principles disclosed. Therefore, it is intended that the scope of the invention be defined and limited only by the appended claims, wherein what is claimed is:

1. An apparatus for inducing sleep in a patient comprising, in combination, circuit means for generating a pulse wave train characterized by a pulse repetition rate of 30 to 40 cycles per second, a pulse amplitude of 18 to 24 volts, and a pulse width of approximately 1.8 to 2.0 milliseconds whereby said wave train is adapted to induce sleep in the patient; rechargeable battery means adapted for connection to a 110 volt A.C. main for charging and recharging; rectifier means connectable at the will of the operator between the battery means and the A.C. main; switch means for connecting the battery means to only one of the charging main and the circuit means at any given time; applicator means adapted to fit the head of the patient; and isolation means comprising an emitter-follower-connected transistor circuit connected between the battery means and the applicator means to pass the pulse wave train to the applicator means and for precluding influence of impedance changes in the patient from being reflected back into the circuit means.

2. An apparatus for inducing sleep in a patient comprising, in combination, circuit means for generating a pulse wave train characterized by a pulse repetition rate of 30 to 40 cycles per second; a pulse amplitude of 18 to 24 volts, and a pulse width of about 1.8 to 2.0 milliseconds; rechargeable battery means adapted to be recharged from a 110-volt A.C. main; a charging circuit for connection to the 110-volt main to supply the battery means; a timer including a switch in circuit with said circuit means; switch means for connecting the battery

means to one of the charging circuit, the timer switch, and the circuit means, at any given time; applicator means adapted to fit the head of the patient; and isolation means, connected between the battery means and the applicator means, comprising an emitter-follower-connected transistor circuit for passing the pulse wave train to the applicator means.

3. Sleep inducing apparatus for use with a human being comprising, in combination, a voltage source; a charging circuit for the voltage source; D.C. voltage to D.C. voltage stepup converter means; timer means including a switch; multiposition switching means between the source, timer means and converter means manipulable at the will of the operator to connect the charging circuit to the voltage source in one position and to connect the source to the D.C. converter means in another position; multivibrator means connected to and responsive to the D.C. converter means for producing a pulse wave train; said wave train characterized by a pulse repetition frequency of approximately 30 to 40 cycles per second, a pulse width of approximately 1.8 to 2.0 milliseconds, and a pulse amplitude of 18 to 24 volts; means for gripping the head of the patient at a plurality of locations for establishing electrical contact therewith; and isolation means comprising an emitter-follower-connected circuit means connected to the multivibrator means and to the gripping means for transferring the pulse wave train to the gripping means while substantially isolating the effects of the patient load.

4. The method of inducing sleep in a human being which comprises the steps of developing a pulse wave train of rhythmic pulses having a variable repetition rate of 30 to 40 cycles per second, a variable pulse width of 1.8 to 2.0 milliseconds and a variable pulse amplitude of 18 to 20 volts; applying the pulse wave form to the head of a patient with energy entry being effected at the nape of the neck and exit through the eyelids; adjusting at least one of the repetition rate, pulse width, and pulse amplitude until the patient barely feels discomfort and experiences alternate black and white color sensations; and maintaining the application of the so-adjusted pulse wave train to the head of the patient for a predetermined time interval.

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RICHARD A. GAUDET, *Primary Examiner.*

LOUIS R. PRINCE, *Examiner.*

65 S. BRODER, *Assistant Examiner.*